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SELECTION OF PATIENTS WITH MITRAL STENOSIS FOR SURGICAL TREATMENT (Valvulotomy)

In about ten percent of cases of rheumatic heart disease endocarditis results in the development of "pure" mitral stenosis. In an undetermined but significant proportion of such instances the person leads a normal or only slightly restricted life for its usual span. Operation is therefore not indicated in patients who display no more than the typical physical signs of mitral stenosis. In the majority, however, and most commonly among women, pulmonary engorgement becomes progressive and disabling, usually during the third to fifth decades of life.

Within the past five years interest has revived in the surgical treatment of mitral stenosis. Methods have been widely and successfully applied to enlarge the mitral orifice either by cutting or tearing along the fused valve commissures. Operative mortality has been 12 percent or less. Relief has sometimes been dramatic; great improvement has been accomplished in well over half the patients, and disability has been reduced in many others. Although the morphological features of the damaged valve cusps and chordae tendineae affect the local success of the surgical procedure, the circulatory results depend largely upon the selection of cases for operation.

The indications for surgical treatment of mitral stenosis derive directly from its dynamic consequences. Increased pressure in the left auricle, referred back through the valveless pulmonary veins, is reflected in altered conditions of pressure and flow in vital areas of the pulmonary circulation. The reserve capacity of the pulmonary vessels is normally considerable; blood flow may be increased several fold without significant signs of engorgement or elevation of pulmonary arterial pressure. With mitral stenosis the available vascular channels in the lungs are already more completely filled at rest, and pressure within these vessels, notably in the pulmonary capillaries, rises with effort or excitement. When hydraulic pressure in these capillary vessels exceeds a critical level, pulmonary edema results as fluid escapes into pericapillary spaces in the alveolar walls. When this condition becomes frequent or persistent respiratory function is locally impaired. When it is widespread the elasticity of the turgid lung is reduced and the reflex stimulus to hyperventilation with exercise is exaggerated. With long-standing engorgement of the lungs pulmonary vascular resistance is increased.

Symptoms of Pulmonary Engorgement—Dyspnea: Most helpful for the evaluation of the patients' circulatory status is their description of their limits of comfortable activity. Occasionally these change only gradually. More commonly after many years without restricting discomfort, during which women patients may have gone through several pregnancies without significant circulatory embarrassment, distressing *breathlessness* often accompanied by cough becomes progressively more severe. Eventually paroxysms of dyspnea interrupt sleep at night requiring additional pillows for comfort.

Pulmonary Edema: What has been said of dyspnea as a manifestation of circulatory disability applies as well to transient attacks of pulmonary edema. Characteristically these occur following effort or excitement and are accompanied by signs of moisture in the air passages or foamy, pink sputum. In patients with mitral stenosis this is not evidence of left ventricular failure but of engorgement in the functional area of the pulmonary capillaries provoked by the relatively too efficient right ventricle. Indeed, when the right heart fails after persistent increase in pulmonary vascular resistance, or, sometimes with the onset of auricular fibrillation, pulmonary edema may not recur.

Hemoptysis—Pulmonary infarction, with sputum containing dark blood or clots, may occur following embolism from the right auricle in the presence of auricular fibrillation, or due to local thrombosis of vessels in the congested lung. Usually these are late manifestations of disease and when accompanied by other embolic phenomena or by right heart failure are cause for caution in recommending operation. Frank hemoptysis, on the other hand, producing relatively large amounts of bright red blood, is a most urgent indication. Such attacks may occasionally follow effort but are not commonly accompanied by other signs of pulmonary congestion. The sources of bleeding are evidently one or more varices of the bronchial veins which afford collateral channels between the pulmonary and systemic venous systems. Such hemoptyses are signs of critical rise of pulmonary venous pressure relative to that in the systemic (azygos) veins, and of fragile collateral vessels. Attacks tend to become more frequent and bleeding more profuse.

Results of Cardiac Catheterization—Physiological

data gathered by cardiac catheterization are helpful but not essential aids in predicting the likelihood of circulatory relief. Cardiac output so determined is usually diminished at rest and fails to increase with mild exercise as in normal persons. Pulmonary arterial pressure is measurably elevated, occasionally above the level of that in the systemic arteries and rises sharply with exercise. Pulmonary "capillary" pressure (recorded with the tip of the catheter in a terminal branch of the pulmonary artery) is usually high. The pattern of pressure most favorable to pronounced post-operative benefit consists of raised "capillary" pressure without excessive elevation of pulmonary artery pressure, suggesting that pulmonary artery vascular resistance has not become high, and, by implication, irreversibly fixed. Arterial oxygen saturation is usually normal at rest but often falls with exercise as pulmonary blood flow fails to increase to meet the new demands. Diminished resting arterial oxygen saturation suggests that changes in the alveolar walls secondary to chronic capillary congestion interfere with diffusion; it cannot be assumed that this function will be restored even though operation relieve the mitral obstruction.

In evaluating the significance of symptoms and signs as indications for surgical treatment of mitral stenosis it is most important to identify other contributing factors and, from the patient's story and by direct observation, to appraise the rate of progress of disability as well as its degree. Occasionally this may be a slow process occupying many years. More commonly a patient may pass from a state without significant discomfort to severe disability within a year or two or even less. Sometimes this may be accounted for by the establishment of auricular fibrillation. Sometimes persistently increased erythrocyte sedimentation rate, leucocytosis, or mild fever suggest continuing activity of rheumatic disease. And, in the advanced stages of disability signs of right heart failure (congestion of systemic veins, hepatic enlargement or peripheral edema) indicate that, due to long-standing engorgement, pulmonary vascular resistance has become fixed at a high level.

CONTRAINDICATIONS—Active Rheumatic Disease: Although fever, leucocytosis, or elevated sedimentation rate may be due to other causes in these patients, unless the alternative cause can be clearly identified caution dictates that the rheumatic state and presumably carditis be assumed to persist. Some of the tragedies attending the operative treatment of mitral stenosis have evidently been due to exacerbation of rheumatic carditis.

Acute bacterial endocarditis: This is an obvious contraindication. Operation upon patients in whom the disease has been cured by antibiotic therapy involves some potential risk that viable bacteria enclosed within the healed, scarred valve may reawaken the local infection. Adequate experience is lacking but a few such cases have undergone mitral surgery and, so far, bacterial endocarditis has not been a prominent post-operative complication.

Intractable Right Heart Failure: When the right heart becomes over-burdened and dilates in the face of long-maintained high pulmonary vascular resistance, and signs of congestive failure with hepatic engorgement appear and persist despite rest and the administration of digitalis and diuretics, circulatory disability has probably reached an irreversible stage. In response to the patient's urgent plea, and lacking

effective alternative treatment, some operations have been undertaken under these circumstances but the mortality is discouragingly, if not prohibitively, high.

Embolism: Auricular fibrillation is not a contraindication in itself but when long established it contributes to the hazard of embolism. There is no certain means to identify mural thrombi prior to operation but history of recent or frequent embolic phenomena sharply increases the risk of post-operative embolism. This has occurred in 3 to 5 percent of the cases.

Mitral Insufficiency: Given the typical physical signs of mitral regurgitation its influence upon the circulatory dynamics in any case is difficult to appraise. Enlargement of the left ventricle is more commonly evident with the combined defects than with mitral stenosis alone. Any considerable enlargement of the left auricle suggests accompanying mitral insufficiency, particularly if dilatation of the auricle with ventricular systole can be demonstrated by fluoroscopy or by roentgenkymogram. Concern regarding mitral insufficiency in these cases is based upon the apprehension that surgical relief of the obstructive narrowing of the orifice may only enhance the adverse circulatory effects of regurgitation.

Lesions of Other Valves: Few cases with multiple valve lesions have undergone operation. On theoretical grounds an obstructive lesion at the aortic valve would seriously compromise the benefit of valvulotomy for mitral stenosis. Following relief of mitral obstruction in such cases a larger proportion of the ventricular contents would flow back through the inflow tract with systole than through the obstructed aortic orifice.

Summary: The selection of cases of mitral stenosis in which favorable results may be expected from surgical treatment rests primarily upon appraisal of the dynamic consequences of mitral obstruction.

Indications: Symptoms and signs of disabling engorgement of the pulmonary circulation:

- (1) Progressively severe dyspnea on exertion or excitement
- (2) Cough or pulmonary edema following effort or excitement
- (3) Paroxysmal dyspnea at rest (often at night)
- (4) Orthopnea
- (5) Hemoptysis

By no means all individuals with the physical signs of mitral stenosis require surgical relief. However, experience indicates that the likelihood of striking benefit diminishes as the duration of the above symptoms lengthens. Operation should, therefore, be advised as soon as progressing disability becomes manifest.

Contraindications:

- (1) Active rheumatic carditis
- (2) Bacterial endocarditis
- (3) Intractable right heart failure
- (4) Frequent or recent embolism
- (5) Mitral insufficiency
- (6) Lesions of other valves, particularly aortic stenosis

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